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ECONOMIC IMPLICATIONS OF WATER POLLUTION ABATEMENT

IN FAMILY FARM LIVESTOCK PRODUCTION

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ABSTRACT

Investments in livestock waste management systems on family farms would range from a few dollars to half or more of total initial cost of modern confinement systems.

Control of animal wastes beyond what farmers are already doing would add to cost with no offsetting change in returns on most farms. The immediate impact of additional pollution abatement is a reduction in income. It would fall more heavily on some producers than others.

Farmers who annually produce about 50 hogs on pasture may be little affected. Net income may be severely reduced, however, on many farms where more hogs are produced in open lots. Added drainage control and waste storage could increase costs as much as $6 per head for a 500-head, open-lot operation. Continued operation might then be unprofitable.

Producers who use complete confinement can very likely meet environmental quality standards for little added cost. Shifting from surface application to soil injection of wastes would raise costs only about $0.16 per hog in a 1,500-head operation. Large-volume (5,000 head) producers without a cropland base could encounter either intolerable added costs or net gains if new ways to capture values from wastes are devised.

A high-quality environment is important to farmers, but impediments to change exist: (1) Farmers and lenders are not certain of the performance of alternative methods of pollution control or the level of environmental quality that will eventually be required; (2) the market offers no economic incentive to change; (3) diseconomies of size exist; (4) age and tenancy make durable investments unattractive; and (5) technical assistance is not yet available in the amount that will be required by new and pending legislation.

Keywords: Animal waste, water pollution, pollution, hogs, cattle, poultry, family-operated farms

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PREFACE

This report expands on material presented by the authors before the President's Water Pollution Control Advisory Board, Peoria, Ill. January 24, 1972. Family farms exist in so many sizes and combinations of enterprises, and vary so much in types of terrain and proximity to water that it is impossible to present data in other than hypothetical terms. Also, Federal and State antipollution statutes are not yet in final form. Therefore, this study aims at: Setting family farm livestock production in the context of one State, Illinois; assessing the economic impact of installing and maintaining water pollution abatement facilities on four representative Illinois hog enterprises; listing ways of financing abatement facilities; summing up North Central and Northeast litigation and legislation on water pollution; and probing impediments to adoption of pollution abatement.

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SUMMARY

Investments in livestock waste management systems on family farms could range from a few cents per animal to half or more of total initial cost of a modern confinement system. For example, thousands of typical Illinois crop-livestock farmers who annually produce about 50 hogs on pasture may be little affected by pollution abatement requirements. Some fencing to keep hogs from streams would probably provide adequate pollution control. New investment of $100 for fencing and an extra annual cost of about $0.30 per head seem reasonable expectations.

Net income may be severely reduced, however, on many Illinois farms where hogs provide much of the income under traditional methods of confinement production. Investment for drainage control and waste storage could cost $15,000 to $20,000 for a 500-head, open-lot operation. Added annual costs could range to $6 per head. Continued operation of livestock enterprises on such farms may be unprofitable, perhaps impossible, if debt exists. Yet two-thirds of total hog production comes from enterprises of this general size.

Most Illinois producers who have specialized to the extent of installing complete confinement systems with liquid waste handling facilities could probably meet environmental quality standards for little added cost. A farmer raising 1,500 hogs could shift from surface application to soil injection of wastes for an added investment of $700--an extra annual cost of about $0.16 per hog.

Producers of 5,000 hogs, especially those without a cropland base, may encounter intolerable added costs for waste management (only a few producers of this size operate in Illinois). However, emerging technology may ultimately give them net gains through ways to capture maximum values from wastes, such as recycling them through the feed supply. Similar situations confront producers of other kinds of livestock and poultry.

Family farmers generally have their homes and businesses at one location. A high-quality environment is of great importance to them, but impediments to change exist in present systems: (1) Farmers and lenders are not certain of the performance of alternative methods of pollution control nor of the level of environmental quality that will eventually be required by law; (2) the market offers no economic incentive to change; (3) diseconomies of size prevent many farmers from using some of the newer technological developments; (4) age and type of tenancy may make durable investments unattractive; and (5) technical assistance is not available in the amount that will be needed to implement the requirements of new and pending legislation.

A legal requirement for additional control of animal wastes would add to cost with no offsetting change in returns on most farms. Farmers are "price

takers," not "price setters." Thus, the immediate impact of additional pollution abatement would be a reduction in income. It would fall more heavily on some producers than others.

Construction and maintenance of pollution abatement facilities, required under existing or pending legislation, will be greatly affected by availability of credit, cost-sharing assistance, and tax regulations. In addition to traditional sources offering credit, USDA's Farmers Home Administration and the Farm Credit Administration can make loans for waste disposal facilities. USDA's Rural Environmental Assistance Program provides limited cost-sharing for construction of vegetated filter strips and lagoons, pits, trenches, and other waste management systems. Tax respites are provided through 60-month amortization or, if the farmer does not elect amortization, investment credit.

Livestock industry groups have not imposed environmental quality standards on member firms because of lack of economic incentive.

Several litigations with livestock producers as defendants in nuisance complaints have been decided in favor of the plaintiffs.

Depending on the use-class of streams in a given area, a statewide statute could affect farmers with similar operations differently in different parts of the State. Also, the degree of enforcement of statutes will vary from State to State, depending on statute provisions and the resources available to State pollution control agencies.

State water pollution control statutes that apply to livestock production in the Northeast and North Central Regions are summarized in the study. (Each State in these regions has such statutes and more statutes are pending.)

ECONOMIC IMPLICATIONS OF WATER POLLUTION ABATEMENT IN FAMILY FARM LIVESTOCK PRODUCTION

by

Roy N. Van Arsdall and James B. Johnson [1]

INTRODUCTION

Society is expressing increased concern about the quality of our environment. Pollution arising from many sources--municipal, industrial, and agricultural--is receiving increasing attention.

Changing farm technology has given rise to more intensive agriculture, leading to concentration of livestock production, intensive use of land resources, and large-scale livestock production. However, several hundred thousand small farms continue to produce livestock. These farms account for a major proportion of the Nation's livestock production and will continue to do so in the foreseeable future.

This report focuses on one segment of the agricultural pollution problem--water pollution caused by animal wastes produced on family farms. Consideration is given to the relative importance of family farms nationally. A close look is taken at the economic setting of livestock production in Illinois, a State which is of major importance in meat animal production and in which family farms are dominant. The economic impact of the enforcement of pollution controls on family farm livestock producers is examined, along with investment requirements, income effects, financing considerations, and possible impediments to adoption of pollution-abating practices.

IMPORTANCE OF FAMILY FARMS

The family farm has long characterized U.S. agriculture. Despite marked changes in size, number, and ways of farming, the family farm continues to hold its own. We define family farm as that which an operator and the average-size family can manage and work mainly on their own. For convenience, any farm that can be operated with less than 1.5 man-years of hired labor has been termed a family farm. On this basis, about 95 percent of all farms are family farms and 5 percent are larger-than-family farms. These proportions have changed very little in the last 30 years. About two-thirds of the sales of farm products are made from family farms.

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Some differences in the proportions of family farms are found between different types of farming (table 1). Larger-than-family farms turn out somewhat more of the total U.S. output of vegetables, fruits, and other field crops than family-size farms. Cash grain, livestock, and dairy farms are predominantly family-size.

Family farms dominate farm numbers in all regions and account for a large part of farm sales everywhere except in the Pacific States (table 2). In the Corn Belt and Lake States, family farms produce nearly 90 percent of all farm products sold.

In 1964--the latest year for which complete census of agriculture data are available--family farms accounted for 77 percent of all cattle and calves on farms, 84 percent of all milk cows, 92 percent of all hogs and pigs, 64 percent of all sheep and lambs, and 64 percent of all chickens 4 months old and over. 2/

When all data from the 1969 census become available for analysis, it seems probable that they will show the same relationships between family farms and all farms as were found in 1964 and earlier years. Farms will be fewer and larger, but the proportion of family farms is likely to be about the same.

FAMILY LIVESTOCK FARMING IN ILLINOIS

Family farms and the relatively small livestock enterprises on these farms occur throughout the United States. They dominate agriculture, however, in the eastern half of the country, especially in the North Central Region, where livestock is of major importance both to farmers and to the national economy.

Family livestock operations differ in many respects from region to region, and even among States within a region. Coverage of all existing variations, however, would unnecessarily complicate an examination of the effects of pollution abatement on family farmers and their livestock production. Since typical livestock operations are found in Illinois, the farming situation in this State will be used to portray the kinds of problems related to pollution abatement in livestock production and probable effects that may evolve from abatement.

An understanding of the existing structure of farm production, the way production is changing, and the reasons for such changes is necessary for evaluating the effect of any additional variable, including pollution abatement.

2/ Nikolitch, Radoje. Family-Size Farms in U.S. Agriculture. U.S. Dept. Agr. ERS-499. 35 pp. Feb. 1972.

Table 1--Family farms and their sales of farm products as percentages of all farms, by type of farm, 1964

Type of farm	Percent of farms that are family farms	Percent of sales made by family farms
Cash grain	97	85
Tobacco	97	82
Cotton	90	42
Other field crop	80	30
Vegetable	83	15
Fruit and nut	83	29
Poultry	92	57
Dairy	94	77
Other livestock	97	69
General	95	70
Miscellaneous	96	29
United States	95	65

Source: Derived from special tabulations made by the Bureau of the Census.

Table 2--Family farms and their sales of farm products as percentages of all farms, by farm production regions, 1964

Region	Percent of farms that are family farms	Percent of sales made by family farms
New England	89	51
Middle Atlantic	93	65
Lake States	98	86
Corn Belt	98	87
Northern Plains	98	82
Appalachian	96	73
Southeast	94	44
Delta States	92	49
Southern Plains	94	55
Mountain	91	46
Pacific	87	29
United States	95	65

Source: Derived from special tabulations made by the Bureau of the Census.

Importance of Livestock

Livestock production is of major importance to Illinois farmers. It accounted for half of cash farm income in 1969 (fig. 1). According to the 1969 census, 85,732 farmers (69.4 percent of all farmers in Illinois) sold \$1.3 billion worth of livestock, poultry, and their products (tables 3 and 4). Together with feed production, livestock production--although more intensive in some areas than others--is dispersed over the State (fig. 2). This distribution of production differs greatly from the intensive concentration of animals within large cattle feedlots in the West and Southwest.

Economic Characteristics of Farms

Farming in Illinois has changed greatly over time but especially during 1964-69 (table 5). Over the 5 years, the number of farms declined by about 2,000 per year, but the decline of livestock farms was more rapid. For example, farms with dairy cows declined 50 percent over the period, and farms with laying hens declined by more than half. These declines are evidence of a continuing cost-price squeeze and the inability of many small-volume producers to make economical use of technological advances in livestock production. Any increase in production cost without offsetting returns will accelerate these declines.

Further characterization of the economic setting of Illinois farms appears in the data on farm size (table 6). Two-thirds of all farmers had less than 260 acres of land in 1969. Without a specialty enterprise, livestock, or an off-farm job, these farmers had little chance of generating enough income to provide an acceptable level of living. The number of farms with sales below \$40,000 annually is an additional indication of the situation faced by the majority of farmers (table 7). Since many farmers had to share receipts from sales with a landlord (table 8), the pressure on income was even more severe than that indicated by gross sales.

One of the strongest clues to the overall economic situation of farming in Illinois is the age of farmers (table 9). In 1969, nearly 40 percent were 55 years old or older, in contrast to 14 percent who were less than 35 years old. This indicates lack of opportunity for new entrants, but perhaps of greater significance is that decisions on pollution abatement will be largely made by older farmers, whose life expectancy influences investments of all types.

Size of Livestock Enterprises

The size of a livestock enterprise determines the technologies that a farmer can use economically. Many technologies, including some of the options available for handling livestock wastes and pollution abatement, are too expensive for use in small enterprises. While livestock production is of major importance in Illinois and the State ranks high in terms of its contribution to national supplies of livestock products, most livestock enterprises there are relatively small and are part of multi-enterprise, crop-livestock businesses.

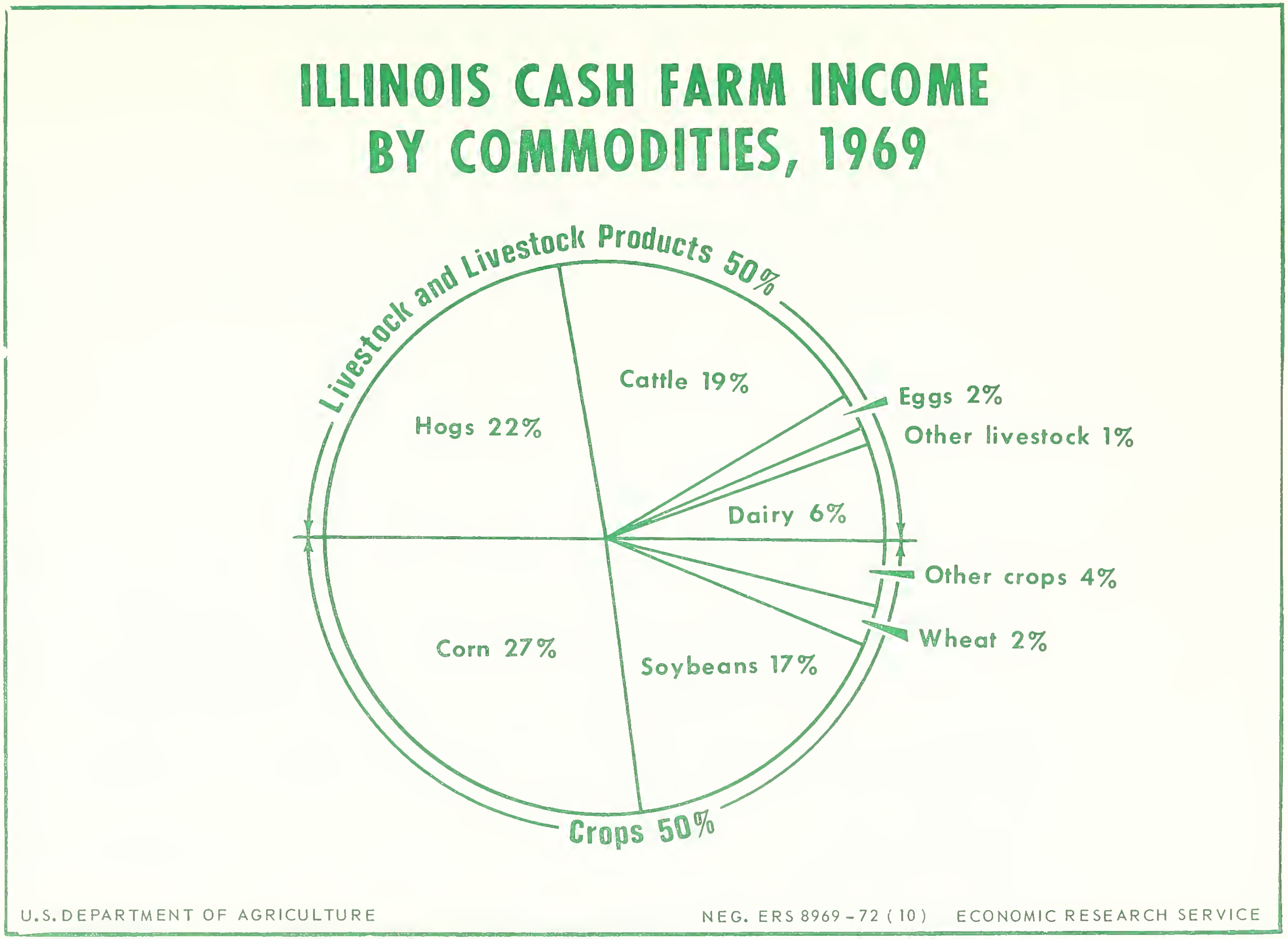ILLINOIS CASH FARM INCOME
BY COMMODITIES, 1969
Livestock and Livestock Products 50%
Hogs 22%
Cattle 19%
Eggs 2%
Other livestock 1%
Dairy 6%
Other crops 4%
Wheat 2%
Corn 27%
Soybeans 17%
Crops 50%
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Figure 1

Table 3--Cash receipts from crops and livestock, Illinois, 1969

Commodity	Receipts	Percent of total
	Million dollars	Percent
Crops:		
Corn	734	27
Soybeans	472	17
Wheat	51	2
Other crops	104	4
Total	1,361	50
Livestock and livestock products:		
Cattle	502	19
Hogs	610	22
Dairy products	156	6
Eggs	50	2
Other livestock	24	1
Total	1,342	50
Total receipts	2,703	100

Source: Illinois Cooperative Crop Reporting Service. Illinois Agricultural Statistics, Annual Summary 1971. Ill. Dept. of Agr. - U.S. Dept. Agr. Bul. 71-1. June 1971.

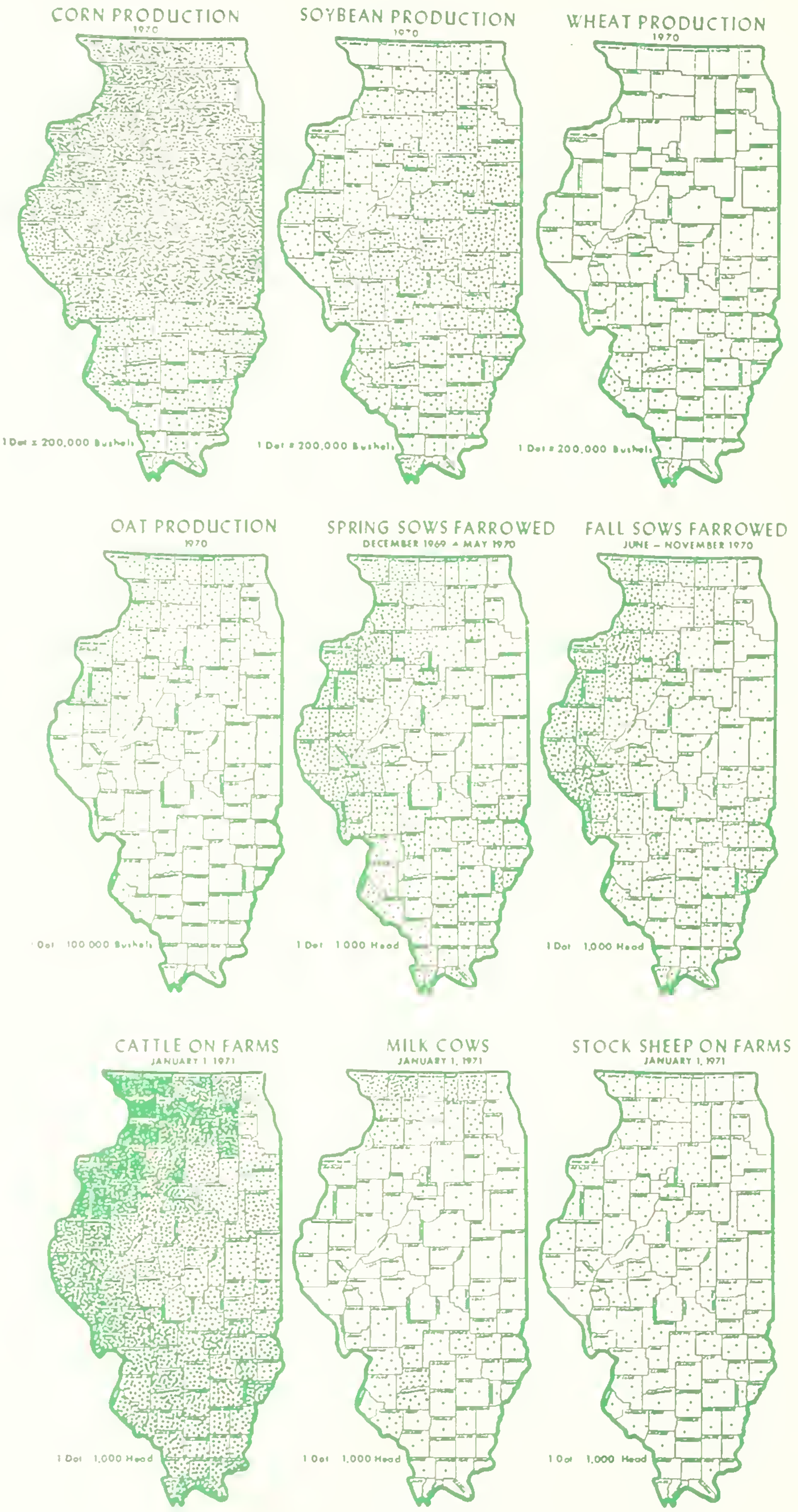
Table 4--Illinois' position in U.S. agriculture, selected data for 1970-71

Commodity group or commodity	Year	U.S. total	Illinois total	Illinois as percent of U.S. total	Illinois' rank among States
		1,000 dollars	1,000 dollars	Percent	
Cash receipts from farm marketings:					
Crops	1970	19,589,405	1,386,520	7.1	2
Livestock	1970	29,088,878	1,356,084	4.7	7
Total	1970	48,678,283	2,742,604	5.6	4
		1,000 bushels	1,000 bushels		
Major crops:					
Soybeans	1970	1,135,769	212,815	18.7	1
Corn	1970	4,109,792	744,884	18.1	2
Oats	1970	909,481	34,272	3.8	6
Wheat	1970	1,378,465	35,748	2.6	12
		1,000 head	1,000 head		
Livestock and poultry:					
Cattle on farms	1971	114,568	3,245	2.8	12
Fed cattle marketed 1/	1970	24,790	1,167	4.7	7
Pigs saved	1970	102,319	11,881	11.6	2
Sheep on farms	1971	19,560	317	1.6	18
Chicken on farms	1971	442,783	10,969	2.5	15
		1,000 pounds	1,000 pounds		
Milk production	1970	117,436,000	2,918,000	2.5	11
		Thousands	Thousands		
Egg production	1970	70,312,000	1,905,000	2.7	15

1/ 22 States.

Source: Illinois Cooperative Crop Reporting Service. Illinois Agricultural Statistics, Annual Summary 1971. Ill. Dept. of Agr.-U.S. Dept. Agr. Bul. 71-1. June 1971.

DISTRIBUTION OF CROPS AND LIVESTOCK IN ILLINOIS, 1970



SOURCE: ILLINOIS CROP REPORTING SERVICE, ANNUAL SUMMARY, 1971.

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Figure 2

Table 5--Number of Illinois farms with specified kinds of livestock and poultry, 1964 and 1969

Type of livestock	1964	1969	Change	
	Number	Number	Number	Percent
All farms	132,825	123,565	- 9,260	- 7.0
Farms reporting:				
Cattle, hogs, or sheep	105,262	81,825	-23,437	-22.3
Cattle and calves	88,192	64,066	-24,126	-27.4
Milk cows	29,628	14,803	-14,825	-50.0
Hogs	66,069	48,475	-17,594	-26.6
Sheep and lambs	17,435	12,535	- 4,900	-28.1
Laying hens	42,206	18,268	-23,938	-56.7

Source: U.S. Census of Agriculture, Illinois, 1969.

Table 6--Number of Illinois farms and acres of farmland, by acres per farm, 1969

Acres per farm	Farms		Farmland	
	Number	Percent	Acres	Percent
1-9	5,110	4.1	15,576	0.1
10-49	13,487	10.9	384,237	1.3
50-69	4,779	3.9	279,486	.9
70-99	10,883	8.8	892,472	3.0
100-139	11,532	9.3	1,352,318	4.5
140-179	13,743	11.2	2,173,847	7.3
180-219	10,062	8.1	1,990,131	6.7
220-259	10,035	8.1	2,384,685	8.0
260-499	31,272	25.4	11,117,312	37.1
500-999	11,239	9.1	7,259,761	24.2
1,000-1,999	1,278	1.0	1,590,615	5.3
2,000 and over	145	0.1	472,750	1.6
Total	123,565	100.0	29,913,190	100.0

Source: U.S. Census of Agriculture, Illinois, 1969.

Table 7--Economic classifications of Illinois farms, 1969

Annual sales	Number of farms	Percent of farms
$40,000 and over	16,630	13.5
$20,000-39,999	25,859	20.9
$10,000-19,999	25,097	20.3
$5,000-9,999	18,729	15.1
$2,500-4,999	14,171	11.5
Class 6	3,595	2.9
Part-time	14,943	12.1
Part retirement	4,519	3.7
Abnormal	22	---
Total	123,565	100.0

Source: U.S. Census of Agriculture, Illinois, 1969.

Table 8--Tenure classification of Illinois farmers, 1969

Tenure	Farmers		Farmland	
	Number	Percent	Acres	Percent
Full owners	56,164	45.4	8,119,596	27.1
Part-owners	36,416	29.5	13,284,023	44.4
Tenants	30,985	25.1	8,509,571	28.5
All farmers	123,565	100.0	29,913,190	100.0

Source: U.S. Census of Agriculture, Illinois, 1969.

Table 9--Age distribution of Illinois farmers, 1969

(Average age - 49.7)

Age	Number of farmers	Percent of farmers
Under 25	3,018	2.4
25-34	14,498	11.7
35-44	25,137	20.4
45-54	34,054	27.6
55-64	30,744	24.9
65 and over	16,114	13.0
All ages	123,565	100.0

Source: U.S. Census of Agriculture, Illinois, 1969.

In 1969, sales of hogs generated more farm income than all other enterprises in Illinois except corn. Over 46,000 farms marketed hogs, which accounted for about one-eighth of total national sales. Nevertheless, half the producers raised fewer than 150 head annually; less than 1 percent turned out as many as 1,400 hogs (tables 10 and 11). Cattle feeding is important, too, but most enterprises are small; over 98 percent of all producers sold fewer than 500 head in 1969 (table 12). This means that the feedlots are also small, since annual output usually exceeds capacity at any given time. The same pattern of size distribution exists for dairy (table 13) and beef cow enterprises (table 14).

Few livestock enterprises of any kind are large enough to fully employ one man. However, more than one kind of livestock is kept on many farms, so enterprise size data do not fully reveal the total numbers of animals per farm.

This is the setting in which most Illinois farmers do business. This is the framework within which adequate livestock waste management is to be achieved, and where the impact of any environmental controls will be felt--the family farm. Though differences occur in other States, farming in Illinois mirrors the problems and effects that will be encountered by family farmers elsewhere.

Characteristics of Livestock Production Systems

The potential problems of pollution from livestock wastes on Illinois family farms and the possible alternatives for their abatement largely depend on the production system, which is closely associated with size of enterprise (already discussed) and the importance of livestock in the total farm business.

Table 10--Size distribution of Illinois hog enterprises, 1969

Hogs sold per farm (head)	Farms		Hogs	
	Number	Percent	Number	Percent
1-24	4,263	9.2	58,085	0.5
25-49	5,102	11.0	186,209	1.7
50-99	8,755	18.8	629,382	5.8
100 and over	28,428	61.0	9,950,869	92.0
100-199	(10,822)	(23.2)	(1,520,371)	(14.0)
200 and over	(17,606)	(37.8)	(8,430,498)	(78.0)
Total	46,548	100.0	10,824,545	100.0

Source: U.S. Census of Agriculture, Illinois, 1969.

Table 11--Distribution of farms and hogs produced, by size of hog enterprise, Illinois, June 1, 1966-June 1, 1967 1/

Hogs produced (head)	Percent of farms	Percent of all hogs
Less than 69	26.5	4.8
69-137	24.1	11.5
138-206	16.4	13.3
207-275	9.7	11.3
276-344	7.3	11.0
345-689	12.1	28.0
690-1,378	3.3	14.3
1,379 and over	0.6	5.8

1/ Based on number of sows farrowed by size groups converted to hogs produced by a given litter size for all groups.

Source: Illinois Agricultural Statistics, Assessors' Annual Farm Census, 1967. Ill. Coop. Crop Rptg. Serv. Bul. 68-5.

Table 12--Size distribution of Illinois cattle feeding enterprises, 1969

Fed cattle sold per farm (head)	Farms		Cattle fattened on grain and concentrates	
	Number	Percent	Head	Percent
1-19	11,087	46.9	99,840	6.4
20-49	5,779	24.4	176,681	11.3
50-99	2,827	11.9	194,841	12.5
100-199	2,174	9.2	299,955	19.3
200 and over	1,792	7.6	787,439	50.5
200-499	(1,430)	(6.0)	(418,309)	(26.8)
500 and over	(362)	(1.6)	(369,130)	(23.7)
Total	23,659	100.0	1,558,756	100.0

Source: U.S. Census of Agriculture, Illinois, 1969.

Table 13--Size distribution of Illinois dairy enterprises, 1969

Milk cows per farm (head)	Farms		Milk cows	
	Number	Percent	Head	Percent
1-19	7,188	53.1	44,859	15.6
20-49	5,124	37.9	161,753	56.2
50-99	1,131	8.4	69,325	24.1
100 and over	81	0.6	11,843	4.1
Total	13,524	100.0	287,780	100.0

Source: U.S. Census of Agriculture, Illinois, 1969.

Table 14--Size distribution of Illinois beef cow enterprises, 1969

Beef cows per farm (head)	Farms with beef cows		Total beef cows on farms	
	Number	Percent	Head	Percent
1-19	21,968	62.4	204,826	28.0
20-49	10,431	29.7	302,140	41.3
50-99	2,219	6.3	143,315	19.6
100 and over	554	1.6	81,354	11.1
Total	35,172	100.0	731,635	100.0

Source: U.S. Census of Agriculture, Illinois, 1969.

Density of Livestock Per Acre

Because of the multi-enterprise crop-livestock organization of most farms, livestock density per acre of land controlled by the farmer remains relatively low. Livestock may be heavily concentrated at one place on the farm, but there is usually a substantial land area available for potential waste disposal.

Farms in Illinois which generate half or more of their income from sales of hogs are an example. Hogs produced annually range in density from 3 to 6 head per acre of total farmland, with greater densities on farms on which more grain is fed than produced (table 15). Commonly, densities are only half these amounts at any one time. Densities are much less on farms that produce hogs but are not classified as hog farms because more income is produced from other enterprises.

In the North Central Region, dairying is usually associated with farmland, because relatively little forage is harvested there for sale. In Michigan in 1970, cropland per cow ranged from 4.6 acres per cow on smaller dairy farms to 3.0 acres on farms with larger herds (table 16).

Intensive Production Systems

Although most livestock production in Illinois remains land based, farmers have steadily moved livestock off pasture into more concentrated production systems. This shift provides the opportunity to: Mechanize materials-handling, increase labor productivity, produce year-round, free land for crops more profitable than pasture, and increase economic efficiency.

Table 15--Estimated number of hogs produced yearly per tillable acre of farmland on hog farms, Illinois, 1970

Acres per farm	Number of hogs produced per tillable acre on farms feeding--	
	50 to 100 percent of crop production	Over 100 percent of crop production
Less than 180	3.4	8.9
180-259	3.2	5.6
260-339	3.2	6.2
340-499	3.0	5.5
500 and over	2.9	6.2

Source: Supervised Illinois farm records, 1970.

Table 16--Relationship of dairy housing and waste handling systems to size of herd and acres of cropland, 311 southern Michigan dairy farms, 1971

Item	Stanchion housing	Stanchion switch housing	Housing and waste handling systems				
			Open-lot housing			Covered housing	
			Bedded area	Free stalls	Liquid system	Scraper-loader system	Liquid system
	Number						
Farms	33	34	30	152	6	40	16
	Percent						
Size of herd:							
30-49 cows	60.6	41.2	46.7	20.4	---	15.0	---
50-74 cows	39.4	35.3	30.0	27.6	---	17.5	25.0
75-99 cows	---	14.7	10.0	25.0	50.0	35.0	25.0
100 or more cows	---	8.8	13.3	27.0	50.0	32.5	50.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Number						
Average per farm:							
Cows	45.7	59.5	60.2	89.3	157.8	87.1	135.6
Other dairy cattle	54.6	65.7	58.5	87.2	183.7	80.8	108.9
Acres of cropland	210	238	277	315	493	280	407
Acres of cropland per cow	4.6	4.0	4.6	3.5	3.1	3.2	3.0

Source: Waste Management Practices and Systems on Michigan Dairy Farms. Mich. State Univ., Dept. Agr. Econ. AER No. 208. Jan. 1972.

Virtually all cattle are now fattened in some type of feedlot rather than on pasture. Most new large hog enterprises use confinement, though most production still takes place on pasture or in combination pasture-drylot facilities. Many dairymen have shifted to year-round harvested feeding programs in drylot. Only beef cows remain in extensive open production systems and get much of their feed from pastures; however, some semiconfinement is coming into use even for them.

The type of production system (degree of confinement) and type of housing used influence when and where the livestock wastes will be produced, the form (liquid or solid) in which they must be handled, the methods by which they can be handled and treated, and the probability of pollution arising from them.

Waste Management Systems

Little is known about the actual mix of livestock production systems, exactly where and under what conditions livestock are produced or exist, or how their wastes are handled. Much more complete and detailed information is needed before the pollution problem and solutions to this problem can be fully evaluated.

Some information on hog production systems in Illinois is available (table 17). In 1971, 8 percent of the producers raised about 15 percent of the hogs in complete confinement systems. The rest were produced on pasture, in drylot, and in combinations of facilities.

All hog wastes not dropped on pasture were handled as solids with conventional equipment by the farmers, except wastes produced in complete confinement. In complete confinement systems, a variety of methods were used for handling wastes in both solid and liquid form (table 18). The most common method used was to retain all wastes in a pit beneath a slotted floor, and then pump, haul, and spread the liquid waste on cropland. The next most prevalent method was to use tractor equipment for removing wastes from solid-floor buildings. Similar information for housing and waste handling systems is available for dairy enterprises in Michigan (tables 19 and 20).

ECONOMIC IMPACT OF POLLUTION CONTROL

The Livestock Producer--A Price Taker

Society will obtain certain benefits from the abatement equipment the livestock producer installs and operates, since it is provided a higher quality environment. Similar benefits accrue to society when a manufacturing firm installs and operates a pollution-abating device.

Table 17--Systems used for finishing hogs to slaughter weight, Illinois, 1971 1/

System	Percent of producers	Percent of hogs
Pasture only	31	23
Paved lot only	16	16
Dirt lot only	18	14
Paved and dirt lot	14	11
Confinement only	6	11
Confinement plus other methods	2	4
Other combinations, excluding confinement 2/	13	21
Total	100	100

1/ Preliminary data from a survey of hog production practices conducted by Illinois Cooperative Crop Reporting Service. Data have been expanded to reflect the State situation.

2/ Systems primarily include combinations of pasture, paved lot, dirt lot, and paved-dirt lot.

Table 18--Methods of handling wastes from hogs finished in total confinement, Illinois 1/

Method of waste removal	Form of waste	Percent of producers
Tractor scraper or loader	Solid	23
All to a lagoon	Liquid	2
All pumped from a pit	Liquid	58
Liquid to a lagoon; solid pumped from a pit	Both	11
Oxidation ditch	Liquid	2
Little or no cleaning	---	4
All methods	---	100.0

1/ Preliminary data from a survey of hog production practices conducted by Illinois Cooperative Crop Reporting Service. Data are for sample respondents only.

Table 19--Number of dairy farms, by type of housing and waste handling systems and size of herd, 311 southern Michigan dairy farms 1/

Housing and waste handling system	Cows per farm				All farms
	30-49	50-74	75-99	100 and over	
	Number of farms				
Stanchion:					
Stanchion	20	13	---	---	33
Stanchion switch	14	12	5	3	34
Open lot:					
Bedded area:					
Scraper-loader-spreader	14	9	3	4	30
Free stall:					
Scraper-loader-spreader	31	42	38	41	152
Liquid system			3	3	6
Covered housing--free stalls:					
Scraper-loader-spreader	6	7	14	13	40
Liquid system	---	4	4	8	16
Total	85	87	67	72	311

1/ A total of 340 survey schedules were returned from 550 mailed out. 29 survey schedules were not sufficiently filled in to use in analysis.

Source: Waste Management Practices and Systems on Michigan Dairy Farms. Mich. State Univ., Dept. Agr. Econ. AER No. 208. Jan. 1972.

Table 20--Waste handling systems and hauling and bedding practices used by Michigan dairy farmers, 6 housing and waste handling systems, 311 farms, 1971

Item	Stanchion	Stanchion switch	Housing and waste handling system			
			Open-lot housing		Covered housing	
			Bedded area	Free stalls	Scraper-loader system	Liquid system
	Percent					
Waste system used:						
Hand load into spreader		20.6				
Gutter cleaner to spreader	100.0	79.4				
Scraper-loader-spreader			96.7	83.6	75.0	
Scraper-ramp-spreader				7.9	22.5	
Scraper-storage-spreader			3.3	8.5	2.5	
Liquid-storage-spreader						100.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
	Days					
Average number of days waste was hauled during year:						
Stanchion housing	305	246				
Open-lot housing		111	67	216	15	7
Covered housing					229	53
	Percent					
Months in which waste was hauled during year:						
Every month	78.7	79.4	43.4	95.4	95.0	37.5
Mostly summer			30.0			
Mostly winter	6.1		3.3	2.6		6.3
Limited months	15.2	20.6	23.3	2.0	5.0	56.2
Total	100.0	100.0	100.0	100.0	100.0	100.0
Kind of bedding used:						
Straw	93.9	64.7	93.3	43.4	40.0	6.2
Sawdust and shavings		2.9	3.3	19.1	25.0	56.0
Sand				3.3	10.0	
Other 1/	6.1	32.4	3.3	34.2	25.0	37.5

1/ Many dairymen used several kinds of bedding, usually straw and sawdust.

Source: Waste Management Practices and Systems on Michigan Dairy Farms. Mich. State Univ., Dept. Agr. Econ. AER No. 208. Jan. 1972.

Most abatement facilities which will be installed and operated by livestock producers to comply with antipollution statutes will probably increase the costs of livestock production. Such a cost increase will initially reduce a farmer's net income, because he will receive no immediate offsetting price increase for livestock products to compensate for his increased costs. The cost of installing pollution abatement facilities will be borne by farmers in varying proportions, depending upon the magnitude of the added cost, the cost structure of the existing enterprise, and the relative importance of the enterprise in the total farm business.

Any individual livestock producer receives the market clearing price that is determined by equating the sum of all consumers' demands for the product with the sum of all livestock producers' supplies of the product. In other words, he takes the price he can get, and does not set it. Any immediate adjustment he chooses to make in his level of output will have no perceptible influence on the price he receives for his livestock products, because even the largest livestock producer now in existence is too small to significantly affect total supply. For example, cattle were being fed to slaughter weight on 185,000 U.S. beef feedlots in 1970.

Short-term adjustments in product prices, regardless of whether the product is manufactured or produced from agricultural operations, can occur only through adjustments in market supplies. Consumer preferences and disposable incomes do not change quickly; consequently, shifts in market demands do not occur immediately.

The livestock firm faced with the adoption of cost-increasing pollution abatement devices for statute compliance has two choices: To discontinue business or to adopt the abatement device and incur an initial reduction in net income because of the increase in costs.

To whatever extent individual producers discontinue production, the total supply of livestock products is reduced, and consumers tend to bid up livestock product prices, as there are few substitutes for meat. This provides the mechanism by which livestock producers who adopt abatement facilities, but maintain their original level of output, recover the added investment in abatement facilities.

On the other hand, many producers will expand their level of output as soon as possible after they add pollution control facilities, so as to take advantage of per unit economies in the added pollution control equipment. As a consequence, total production may not decline much, and product price may not increase appreciably. Unless economies are realized in the usual resources involved in livestock production, such as feed and labor, only part of the per unit profit margin will be maintained. In these circumstances, individual livestock producers who wish to maintain income levels will increase the level of output to offset the reduced per unit profit margins. This adjustment would occur after the producer incurs the initial reduction in net profits.

Impact in Different Illinois Farm Situations

The extent of water pollution caused by different kinds of livestock systems and the precise measures that will be necessary to control that pollution are largely unknown. Nevertheless, it seems highly probable that neither sources of pollution nor the costs of abating pollution will bear equally on all livestock producers. Quite possibly, most of the pollution stems from one or two groups of producers. Some may be able to bear the costs of abatement during the adjustment process; others may not. Therefore, consideration should be given to where the impact of abatement of pollution might be felt most strongly and what the consequences might be if all abatement costs are borne by producers.

Four Hypothetical Hog Enterprises

At present, the variability of impact of antipollution measures can be illustrated only on a hypothetical basis. Let us consider hog production, since this enterprise accounts for 22 percent of Illinois cash farm income and involves over 46,000 farmers. The following is a brief discription of four family-size hog enterprises--small, medium, large, and very large. Similar-sized hog enterprises can be found throughout Illinois and the North Central Region. The analysis would be similar for beef cattle and dairy enterprises in the region.

Small.--50 hogs produced on pasture from a late spring farrowing on a crop farm. Facilities are minimal. About half of the hog producers in Illinois raise fewer than 150 head; these producers account for about 15 percent of total output in the State.

Medium.--500 hogs produced on a crop-hog farm. Farrowing takes place in a central house. Summer pigs are finished on pasture; winter pigs are housed in an open-front shed with paved lot. A storage pit for manure is at the edge of the paved lot. Output of most Illinois hog producers--other than small producers--falls within 200 head of this size and accounts for about 65 percent of total output. Hogs are major income producers on these farms.

Large.--1,500 hogs produced in total confinement on a crop-hog farm. New facilities tend to be of this general type because of advantages associated with confinement. Presently, fewer than 5 percent of producers are in this category. They probably produce about 15 percent of total output.

Very Large.--5,000 hogs produced in the same type of total confinement, but there is relatively little cropland. Only a few such operations exist.

Enterprise Cost Structure

To examine the probable impact of an added cost to prevent pollution from hog wastes in these examples, we must estimate the cost structure of each size of hog enterprise and the abatement cost that might be incurred for that size.

First, let us characterize the costs of production. In figure 3, the total cost of pork production per hundredweight is assumed to be the same for each enterprise. (The average unit cost may differ among these enterprises, but the difference in impact of an added cost can best be demonstrated with equal costs.) The height of the bars, AB, represents average total costs. The level of total costs is important, but the absolute magnitudes of average fixed costs, BC, and average variable costs, AC, are of major significance in an ongoing enterprise. It is profitable for a farmer to continue production as long as variable costs, AC, can be recovered plus some additional return for fixed or sunk resources, BC, (buildings, for example). Cessation of production would result in no return to fixed resources. Depending on the debt situation, some fixed costs may need to be paid each year in the form of debt service, lessening the capacity of the fixed resources to absorb the added cost of pollution control.

Nearly all costs are variable for the small hog enterprise. Feed conversion efficiency is low, cost of supplement is high, and few buildings and little equipment are used. The medium-size enterprise has lower average variable costs because investments have reduced labor requirements, feed conversion efficiency is higher, and volume purchases reduce the unit cost of purchased feed. The large and very large enterprises have even more of their costs shifted from the variable to the fixed category because of heavier investment in long-term capital inputs, some of which are facilities to control pollution.

Basis for Investment Decisions

In an ongoing enterprise, the farmer makes decisions on the basis of variable costs in relation to returns. A pollution abatement system which is not yet installed remains a variable cost because a farmer can avoid that cost if he ceases production. Thus, his decision as to whether to add the abatement system and continue production or quit hinges on whether the incremental costs of the contemplated abatement system--CD in figure 3--plus existing average variable costs--AC--are less or more than product price. Since the anticipated returns stay about the same, any increase in cost to abate pollution, CD, will reduce returns available to offset existing fixed costs (new waste management technology could conceivably result in a net benefit, CD', thus increasing returns). He hopes that by staying in business, he will eventually be able to recover the added cost which he temporarily absorbs by not receiving a full rate of return on his original investment in fixed resources.

In the example situations, a relatively small addition to existing average variable costs would clearly make continued operation unprofitable for the small enterprise. Farmers with the larger enterprises would remain in operation in the face of much greater additions to existing average variable costs (even though their returns to existing fixed facilities would be lessened).

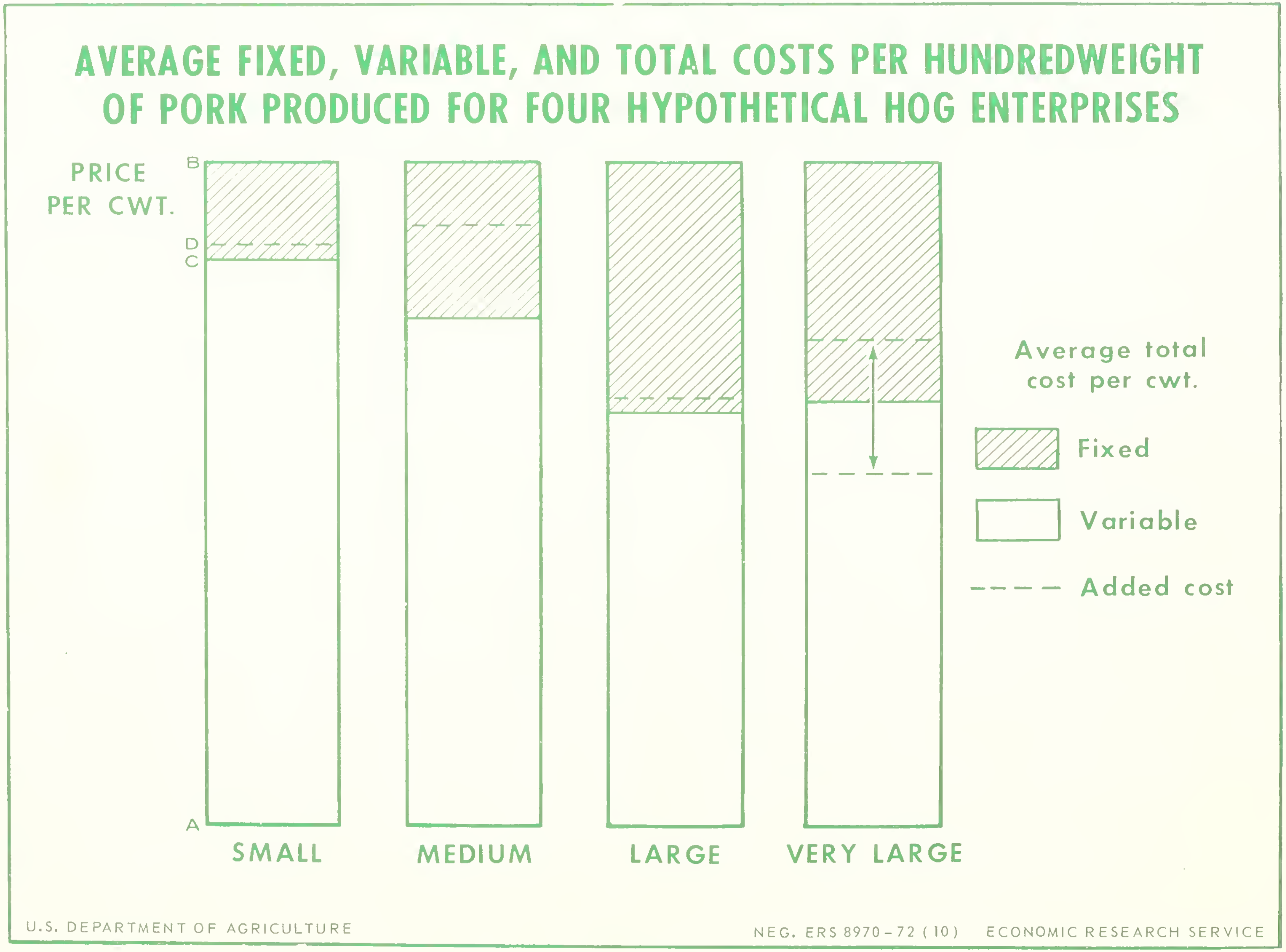
AVERAGE FIXED, VARIABLE, AND TOTAL COSTS PER HUNDREDWEIGHT OF PORK PRODUCED FOR FOUR HYPOTHETICAL HOG ENTERPRISES
PRICE PER CWT.
B
D
C
A
SMALL
MEDIUM
LARGE
VERY LARGE
Average total cost per cwt.
▨ Fixed
☐ Variable
---- Added cost
U.S. DEPARTMENT OF AGRICULTURE
NEG. ERS 8970-72 (10)
ECONOMIC RESEARCH SERVICE

Figure 3

Pollution Problems, Remedial Actions, Costs, Consequences

Each of these four farms very likely poses a different problem which only an on-site case study can evaluate, but for illustration let us pose the pollution problem, remedial action, added cost, and consequences.

Small Enterprise (50 hogs)

Problem: Hogs get into nearby stream.

Remedial action: Install 40 rods of fence.

Added cost:

	Initial	Annual		
		Total	Per hog	Per cwt. of pork
Fence	$100	$15	$0.30	$0.15

Consequences: Added cost is nominal. The farmer will very likely comply and continue production. However, cessation would have little effect on farm income.

Medium Enterprise (500 hogs)

Problem:
(a) Pit overflows during heavy rains and some effluent runs into nearby stream.
(b) Liquid manure is spread on cropland throughout the winter; occasional runoff occurs during rains.

Remedial action:
(a) Construct a 1-acre fenced retention basin to intercept lot drainage and any pit overflow.
(b) Construct a 200-yard terrace above the farmstead to intercept drainage and protect retention basin.
(c) Increase capacity of concrete manure pit from a 2-month supply to a 6-month supply.
(d) Spread manure on cropland only during growing season.

Added cost:

	Initial	Annual		
		Total	Per hog	Per cwt. of pork
Retention basin	$ 2,000	$ 300	$0.60	$0.30
Terrace	750	112	.22	.11
Enlarged concrete pit	13,000	1,950	3.90	1.95
High-cost labor to handle manure during cropping season	---	290	.58	.29
	$15,750	$2,652	$5.30	$2.65

Consequences: Added cost is high enough to wipe out a large portion of the present return above variable costs. The farmer may comply, but the contribution of the hog enterprise to farm income will be seriously impaired. If debt exists, the cost of the remedial action may be intolerable. In an attempt to maintain farm income, the farmer may drop hogs and shift to intensive row crop production, possibly creating a soil erosion and sedimentation problem downstream.

Large Enterprise (1,500 hogs)

Problem: Liquid manure is spread only during the growing season, but occasional runoff from sloping land gets into nearby stream during heavy rains.

Remedial action: Add soil injection attachment to present liquid applicator tank and abandon surface application.

Added cost:

	Initial	Annual		
		Total	Per hog	Per cwt. of pork
Soil injector	$700	$105	$0.07	$0.04
Extra use of tractor	---	139	.09	.04
	$700	$244	$0.16	$0.08

Consequences: Added costs are nominal. Substantial investments have already been made in the waste handling system, which is nearly capable of maximum pollution abatement. The farmer will comply. The trend toward this type and size of operation will be further encouraged.

Very Large Enterprise (5,000 hogs)

Problem: Effluents are not adequately treated with conventional procedures and are causing both runoff and ground water pollution.

Remedial action: Acquire or arrange for use of additional farmland or install one of the new waste processing systems now in the experimental stage.

Added cost: Impossible to estimate with present knowledge.

Consequences: Possibilities are twofold. First, developing technology may prove inadequate to control pollution at acceptable cost in such highly intensive systems, thus forcing hog production to return to a more extensive land-based system of production where wastes can be spread in the fields. Second, developing technology may effectively control pollution at an acceptable cost and even reduce the present level of variable costs (for example, the recycling of wastes into the feed supply), thus giving the large specialized operation an insurmountable advantage over other producers. These possibilities may also apply to large dairy and beef cattle operations.

The examples posed for these four hog enterprises are hypothetical, but they could well occur in real life. Enterprises to be started in the future will of course be evaluated on the basis of all costs, and investments will be made only when anticipated product price is sufficient to cover these costs.

Investments in Waste Handling Systems

Waste handling is and always has been a major problem for farmers who raise livestock on drylot or in confinement. They have continually sought ways of reducing labor requirements and even eliminating the task entirely. As a result, types of housing and waste handling equipment have proliferated. Many farmers have substantial investments in their waste handling systems.

As an example of the magnitude of these investments, a hog producer desiring to buy feeder pigs and finish 1,500 hogs annually, with facilities utilized to capacity year-round, could choose from systems with investment requirements ranging from $1 to over $23 per hog (table 21). For complete confinement, the waste handling system may constitute half or more of the total investment in facilities.

Initial investment requirements would be substantially higher for waste facilities in a complete farrow-to-finish system for producing 1,500 market hogs annually. A fully equipped slotted-floor unit for this capacity, with equipment for pumping and hauling liquid wastes to the fields for surface application, now costs about $75,000, or nearly $50 per hog produced (table 22). Yet a hog enterprise of this size utilizes only about two-thirds of a man-year of labor.

The investment requirements for waste handling systems for cattle feeding and dairy enterprises also differ by type of system and size of enterprise. For dairy enterprises, the investment in waste handling facilities in Michigan ranged from $59 to $193 per cow, depending upon the handling system and size of herd (table 23).

Should any present waste handling systems be found inadequate for pollution control, then investments will be increased by the further amounts required. Also, unit costs are affected by size of enterprise in all systems. Thus, the heavy financial burden for the small-volume producer is quite evident.

Waste handling systems cannot be fully evaluated by the level of investment or operating costs alone. Most such systems are an inseparable part of a total production system. Labor requirements and hence productive capacity of

Table 21--Initial and annual costs for alternative waste handling systems for growing and finishing 1,500 hogs per year, Illinois, 1971 1/

Manure handling method	Annual marketings	Initial cost		Annual cost			
		Total	Per hog	Equipment	Operation cost	Total	Per hog
	Head	Dollars					
Bulk spreader and loader	1,500	2,000	1.33	370	80	450	0.30
Anaerobic lagoon	1,500	3,400	2.27	374	---	374	.25
Pit under facility	1,500	18,607	12.40	3,035	180	3,215	2.14
Oxidation ditch	1,500	16,970	11.31	3,027	1,150	4,177	2.78
Botkins waste handling system	1,500	35,000	23.33	5,600	2,230	7,830	5.22
Waste refeeding	1,500	25,920	17.28	4,504	3,000	7,504	5.00
N and P removal:							
Small system	500	17,940	35.88	2,690	3,327	6,017	12.03
Medium system	2,000	37,750	18.88	5,570	6,382	11,952	5.98

1/ The waste handling system includes all equipment for handling the wastes, and all facilities for collection and storage, including solid or slotted floors, pits beneath buildings, and outside lagoons.

Source: Gamble, John C. Economic Evaluation of the Impact of Alternative Environmental Regulations on Illinois Hog Producers. Unpublished Ph.D. thesis. Univ. Ill. 1972.

Table 22--Investments and annual costs for buildings and equipment for confinement production of 1,500 hogs annually--6 farrowings, Illinois, 1971 1/

Item	Cost
	Dollars
Investment:	
Farrowing (totally slotted) @ $675 per sow	21,600
Nursery (totally slotted)	10,200
Growing-finishing (totally slotted)	32,100
Sow facilities (in field)	3,500
Feed processing	4,500
Manure equipment (liquid wagon)	2,300
Total	74,200
Per litter	386
Per hog marketed	49.47
Annual cost: 2/	
Total	13,356
Per litter 3/	69.56
Per hog marketed	8.90

1/ Based in part on Mueller, A. G., and R. P. Kessler, Investment Opportunities in Hog Production Under Three Building Systems. Univ. Ill., Dept. Agr. Econ. FM-32. May 1970.

2/ 10 percent for depreciation, 8 percent interest on average investment, 3 percent on repairs and maintenance, and 1 percent for taxes and insurance.

3/ Based on 192 litters.

Table 23--Investments in complete waste handling systems for open-lot and covered-housing systems, 3 dairy herd sizes, Michigan, 1971

Item	Dairy herd size group					
	50-74 cows		75-99 cows		100 or more cows	
	Scraper-loader system	Liquid system	Scraper-loader system	Liquid system	Scraper-loader system	Liquid system
	Number					
Open-lot free-stall housing:						
Farms	42	---	38	3	41	3
Cows per farm	61	---	86	---	157	---
Acres cropland per cow	4.3	---	4.1	---	2.7	---
	Dollars					
Investments:						
Manure spreader	1,404	---	1,924	---	1,988	---
Scraper and loader	1,388	---	2,230	---	2,537	---
Tractors	4,266	---	4,485	---	4,766	---
Total	7,058	---	8,639	---	9,291	---
Per cow	116	---	100	---	59	---
	Number					
Covered housing:						
Farms	7	4	14	4	13	9
Cows per farm	62	62	84	93	123	194
Acres cropland per cow	3.7	5.2	3.5	2.8	2.9	2.7
	Dollars					
Investments:						
Manure spreader	1,493	883	1,319	1,233	1,988	2,016
Scraper and loader	1,611	884	1,515	912	2,537	588
Tractors	5,030	1,900	4,411	3,200	4,766	8,735
Pump and agitator	---	1,407	---	1,458	---	1,489
Liquid spreader	---	1,450	---	1,650	---	1,623
Storage tank	---	5,415	---	7,375	---	9,386
Total	8,134	11,939	7,245	15,828	9,291	23,837
Per cow	131	193	86	170	76	123

--- = not applicable.

Source: Waste Management Practices and Systems on Michigan Dairy Farms. Mich. State Univ., Dept. Agr. Econ. AER No. 208. Jan. 1972.

the farmer are affected. The waste may be destroyed or it may contribute to the nutrient needs of crops; perhaps it could even be recycled into the livestock feed supply. The total system determines whether production is seasonally restricted or continuous. Health of the animals and their effectiveness in utilizing feed may be affected. Research has been initiated to identify the balances of these and other such ramifications.

WAYS OF FINANCING POLLUTION ABATEMENT FACILITIES

Regulations requiring adoption of pollution abatement facilities are necessary, but are not a sufficient condition for obtaining pollution abatement. Farmers must also have or be able to get the funds needed to control pollution and still stay in business. Construction and maintenance of waste disposal systems required under existing or future legislation will be greatly affected by availability of credit, cost-sharing assistance, and tax regulations. Present economic incentives to livestock producers for solving animal waste management problems are not adequate to encourage the adoption of improved facilities nor are lenders encouraged to finance investments in improved facilities.

The Rural Environmental Assistance Program (REAP), administered by USDA's Agricultural Stabilization and Conservation Service (ASCS), provides cost-sharing assistance to farmers. This assistance, while helpful, is currently limited in scope. Tax incentives are provided through rapid amortization and investment credit, described below. Rapid amortization, however, is the only incentive to investment in animal waste management, since investment credit applies to other capital expenditures, including those which increase income.

No special loan programs are available for financing animal waste management investments. [3] Such investments, however, qualify under most regular loan programs. Details of credit sources and lender attitudes, cost-sharing incentives, and tax regulations affecting investment in pollution control facilities follow.

Sources of Credit and Lender Attitudes

A farmer's ability to obtain credit from usual sources depends mainly on his prospects for repaying the loan within a reasonable length of time. The purpose for which a farmer uses the credit would not ordinarily be an important restriction. Thus, credit to construct animal waste abatement facilities would be generally available if the farmer's repayment capacity is satisfactory.

Federal land banks, life insurance companies, and commercial banks are major institutional lenders that make long-term loans for farm improvements secured by farm real estate. Commercial banks and production credit associations are important suppliers of short-term credit for farm investments. Farmers Home Administration (FHA) loans are available on both long-term and short-term bases to eligible farmers who are unable to get credit elsewhere on reasonable terms.

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[3] Title I of the Rural Development Act of 1972 (P.L. 92-419) authorizes additional loans and cost-sharing grants for pollution abatement and control projects in rural areas; however, funding remains uncertain.

As with any other farm improvements, installation of pollution abatement facilities would be an eligible purpose for FHA loans under the Federal farm ownership and operating loan programs. The FHA soil and water conservation lending program includes provision for financing abatement facilities in connection with soil conservation needs. FHA interest rates are usually below market rates.

Although pollution abatement is an eligible purpose for most lenders, many farmers may not be able to get financing for such facilities because they do not add to earning capacity. This is, of course, most serious for marginal farmers who already have all the debt they can handle. Even qualified farmers would probably be reluctant to borrow for investments that would not increase income and would have to be repaid from the present level of earnings.

Laws and regulations requiring pollution abatement add another uncertainty that farmers and lenders must face. One problem that concerns lenders in making intermediate or long-term loans for antipollution purposes is the possibility of rapid obsolescence of equipment and facilities due to changing technology and environmental standards. Debt commitments for waste disposal facilities might also have an impact on availability of credit for regular farm production purposes. It is conceivable that a lender might turn down a loan request for regular investment purposes if there was a possibility that the borrower might be later forced to take out another loan for pollution abatement.

Farm Credit Administration (FCA) agencies have had only a limited amount of experience in lending for waste disposal systems, because, as discussed earlier, farmers' investment in new pollution abatement systems has been limited thus far. For some farmers who have borrowed from FCA, relocation of the farm or facility because of waste control requirements has brought problems of high cost, lost income, and repayment difficulties. Such problems should be overcome with experience.

The Small Business Administration (SBA) can make loans to commercial feeding yards which provide housing and feeding for livestock owned by others. The feed must be purchased and not produced by the yard owners. Thus, financing animal waste facilities on farms or livestock feeding operations producing their own feed or young stock would not be an eligible purpose for SBA.

There are some social incentives for private lenders to finance animal waste facilities and they may do so where the additional debt can be handled by the farmer. Loans in many instances, however, will be restricted because of the extra risk involved. Long-term, low-interest-rate loans requiring subsidy from State or Federal sources may be needed to encourage construction of facilities. The Farmers Home Administration is one such source.

Conditions that would make loans for pollution abatement more attractive to lenders include more technical assistance, better estimates of costs and impacts on farm earnings, more cost-sharing by the Government, and greater tax incentives.

Cost Sharing

Frequently, the financial ability of the farmer to make the necessary investments for pollution abatement, using his own resources and credit, is overtaxed. To help overcome this impediment, USDA provides cost-sharing payment incentives for conservation and waste management.

One USDA program is the Rural Environmental Assistance Program, mentioned above. REAP provides limited cost-sharing assistance for pollution abatement, primarily for solving animal waste and sediment pollution problems. Examples of eligible projects pertaining to animal waste management include:

1. Construction of lagoons, pits, trenches, diversions, and other management systems. Cost sharing cannot be used to build a new slotted-floor barn, but can be used for the collecting pit under the slotted floor.

2. Vegetated filter strips. These strips provide a barrier between a source of pollution on the farm and any stream nearby.

Cost sharing for practices primarily for pollution abatement (which also conserve soil or water) was initiated under the 1970 Agricultural Conservation Program (ACP). (The program became the Rural Environmental Assistance Program (REAP) in 1971). About $1.4 million of these cost-sharing funds was used for these practices under the 1970 program, primarily for animal waste management activities (table 24). In the second year of these practices (the 1971 REAP), cost-share expenditures increased to $8.8 million, with $3 million of the increase for the animal waste management measures. Further increases in the use by farmers of these REAP practices are being experienced in 1972.

Technical responsibility for REAP animal waste management practices is assigned to USDA's Soil Conservation Service. One of the constraints at present is that most States do not have large enough staffs to provide technical assistance, project designs, and approval of construction as rapidly as is requested.

REAP funds are allocated to State ASC committees on the basis of an evaluation of the conservation needs of the respective States as determined by the Secretary of Agriculture, with certain limits on any reduction from the previous year's allocation. State ASC committees, in turn, allot the funds to county ASC committees.

Table 24--Pollution abatement practices, number of facilities built, and cost-share expenditures under ACP/REAP, 1970-71

Pollution abatement practice	1970			1971		
	Number	Cost-share	Number of States involved	Number	Cost-share	Number of States involved
Animal waste lagoons	799	$ 611,997	35	1,053	$1,082,231	43
Animal waste storage	483	425,416	29	1,848	2,691,042	44
Diversions for animal waste management	295	156,370	29	986	464,784	39
Other animal waste management	85	36,128	7	9	4,842	3
Sediment-related measures	1/225	119,913	2/	1/8,702	3,903,999	2/
Other antipollution measures	1/127	67,794	2/	1/1,676	621,858	2/
Total		$1,417,618			$8,768,756	

1/ Number of farms rather than number of installations may include duplication where more than 1 kind of measure is installed on 1 farm.

2/ Number of States varies by practice.

The highest priority in the allocation of REAP funds is given to enduring measures which individually or collectively result in significant public benefits. However, large nonfarm commercial enterprises are not eligible under REAP, due in large part to limited funds and the farm and ranch orientation of the program.

REAP cost-shares generally average about 50 percent of the cost of construction of facilities approved for combating agricultural pollution. This share of costs may range up to 80 percent for low-income farmers and for certain high-priority practices and projects, and up to 90 percent for tree and shrub plantings and timber stand improvements. The share of costs for all conservation and pollution abatement practices under REAP is generally limited to $2,500 for each producer per year, with lower limits in effect in many States and counties.

Special projects may also be developed for groups of producers and entire communities working together to combat specific, common, farm-based pollution problems.

Tax Regulations

Current Federal income tax regulations provide two measures that reduce the hardship of investment in pollution control facilities and perhaps provide some incentive for such investments. These are rapid amortization and the 7-percent investment credit.

Rapid Amortization

Farmers may elect amortization over a 60-month period for certified pollution control facilities placed in service before 1975 and added to or used in connection with a plant in existence before 1969. The amortization deduction is available only for the first 15 years of the useful life of the facility. 4/ Thus, if a facility has a 20-year useful life, 75 percent of its cost would be amortizable over 60 months and 25 percent would be subject to regular depreciation over a 20-year useful life.

The amortization deduction elected under the provision replaced the deduction for depreciation. But the additional first-year, 20-percent depreciation allowance is still available.

Investment Credit

Investment credit will not be available for the pollution control facilities if the farmer elects the rapid amortization provision for the first 15 years of the facilities' useful life. However, the credit applies on the

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4/ U.S. Master Tax Guide, 1972. Commerce Clearing House. Sec. 1159A.

cost attributable to the useful life in excess of 15 years. If the farmer does not elect rapid amortization, investment credit applies to the entire value of pollution control facilities, if they come under the definition of "section 38" property as identified in the U.S. Internal Revenue Code. Buildings and their structural components do not qualify for investment credit under this provision. However, facilities for storage of wastes appear to qualify.

Investment credit for water and air pollution control facilities that are certified under both State and Federal control programs was not suspended by 1969 Federal income tax regulations, as was the credit for many other investments.

POLLUTION CONTROLS AND STATUTES AND LITIGATION ON LIVESTOCK PRODUCTION 5/

Environmental quality controls are forthcoming from (1) individual legal actions taken by those personally damaged by animal waste pollution, (2) individual legal actions taken by those not personally damaged, and (3) collective actions initiated by the Federal Government and State and local governments. Livestock producer resource adjustments have been encouraged or have occurred under each type of action.

Another source of environmental quality control would be voluntary actions adopted and self-imposed by beef feeding, dairy, or other livestock industry organizations. Up to now, resource adjustments encouraged through voluntary adjustment programs developed by livestock industry groups have not been substantial. Farm industry groups have been reluctant to impose environmental quality standards on member firms. This does not imply a lack of awareness of the environmental quality problems arising from the production processes of member firms, but suggests that group leaders recognize there are no economic incentives for member firms' voluntary compliance with group-initiated quality standards. More complete knowledge of the economic consequences will be needed before industry group leaders can be expected to effectively encourage voluntary resource adjustments by producer members.

5/ Much of this section was taken from a paper presented at the 1972 Cornell Agricultural Waste Management Conference entitled Implications of State Environmental Quality Legislation on Livestock Waste Management, by J. B. Johnson, L. J. Connor, C. R. Hoglund, and J. Roy Black. Additional information on the status of State water pollution regulations can be gained by referring to this paper, and the following: (1) Connor, L. J., J. B. Johnson, and C. R. Hoglund. A Summary of State Regulations Pertaining to Animal Waste Management in the North Central Region of the United States, Mich. State Univ. Agr. Econ. Rpt. No. 193, May 1971. 25 pp.; (2) Schiewsow, W. F. A Summary of State Regulations Pertaining to Livestock Feedlot Design and Management--Dec. 1970, U.S. Dept. Agr., ARS-189, Apr. 1971. 8 pp.; (3) Sweeten, J. M. State Agencies Regulating Confined Animal Feeding Operations, U.S. Environmental Protection Agency, unnumbered rpt., 1971. 35 pp.

Several North Central Region litigations based on common law prohibitions against personal damage from private or public nuisance have been decided in favor of the plaintiffs. Resource adjustments of economic consequence to livestock producers have ranged from payment of actual and punitive damages by some defendants to permanent restraint of others from further use of confinement feeding facilities in future livestock feeding activities. Even where court decisions require no resource adjustments by the defendant, the costs of litigation can create serious economic consequences for producers. A recent court decision and the provisions of the Michigan Environmental Protection Act passed by the 1970 Michigan legislature have effectively provided opportunity for a person with no economic stake in an alleged or real act of pollution to bring legal action for relief of the alleged violation.

A summary of the forms of State water pollution statutes is presented for the North Central Region and the Northeast in table 25. The various forms of water pollution control statutes in these two regions are discussed below.

Table 25--Forms of State water pollution statutes applicable to the management of livestock wastes, Northeast and North Central Regions, 1971

Forms of State statutes	States with provisions, by production region
General water pollution legislation	All States surveyed in the two production regions
Legislation or administrative codes specific to livestock wastes	Northeast: Maine, Massachusetts North Central: Indiana, Iowa, Minnesota
Considering legislation or administrative codes specific to livestock wastes	Northeast: Maine, New Jersey, Pennsylvania North Central: Illinois, Missouri
Registration or permit for livestock production or operation of discharge point or abatement equipment	Northeast: Connecticut, Maine, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island North Central: Indiana, Iowa, Minnesota
Registration based on number of head of livestock or quantity of waste	Northeast: Maine North Central: Indiana, Iowa

Each State in the North Central and Northeast Regions has general water quality statutes which can apply to the management of livestock wastes. Livestock operations (or other types of agricultural production) are not explicitly cited as potential pollution sources in the statutes, but general statute provisions have been or can be applied to problems arising from livestock pollution.

The development of general State water quality statutes was given impetus by section 10 of the Federal Water Quality Act of 1965, which required each State to adopt water quality standards applicable to interstate waters and plan for the implementation of the water quality standards adopted. The deadline for States to comply with the requirements of section 10 of this act was June 30, 1967. After public hearing and approval of each State's water quality standards relative to criteria established by the Federal Water Pollution Control Administration (predecessor of the U.S. Environmental Protection Agency), these standards became applicable to the interstate waters or portions thereof for that State and are enforceable by both the Federal Government and the State water pollution control agency.

Maine and Massachusetts enacted legislation on management of livestock wastes which extends beyond most State's environmental quality statutes. Maine's regulations control the disposal of poultry and poultry parts and prohibit the disposal of offal and feathers upon any public way, including inland and tidal waters. Massachusetts' statute prohibits pollution and secures the sanitary protection only of water used as sources of human drinking water; for this purpose, the statute requires that no cattle or other animals be housed or otherwise confined within 50 feet of the high water mark of water supply sources.

Minnesota, Indiana, and Iowa have specific legislation which requires the registration of certain livestock production activities, based on criteria such as type of livestock, number of animals held in confinement, location of the production facility with respect to waterways, and type of waste management practices employed.

Legislative and administrative code changes are being considered in several States. Some proposed changes are additions to and changes in rules and guidelines needed to implement previously established legislation or administrative codes; others are new legislative and administrative codes designed to facilitate control of an acute, new, or previously unrecognized problem.

The Maine legislature recently considered but did not approve two legislative proposals, one concerned with the disposition of animal wastes on land or in waters, and the other related to the timing of manure applications to limit the drainage therefrom to inland or tidal waters.

Currently, an assessment is being made in New Jersey to determine if specific administrative codes applicable to livestock waste pollution are needed to fully implement that State's general water quality statute provisions. Pennsylvania is currently developing new requirements for the handling and disposal of soild wastes, which will include animal wastes.

Illinois will soon have public hearings on proposed animal waste regulations and a suggested permit system for proposed or expanding concentrated livestock enterprises and for existing livestock enterprises not in compliance with other regulations. Missouri is considering introduction of legislation on the control of water pollution arising from livestock feeding operations. In Iowa, public hearings are being held to determine the desirability of expanding the registry requirement to most classes of livestock being produced in confinement feeding facilities or in open feedlots over a given size.

Registration and permit requirements are of two general types. The first type has been established by specific legislation which requires the registration of or a permit for the continued operation of a livestock production facility or both (table 26). The second type has been promulgated under general State water quality statute provisions and usually requires the approval and issuance of a permit for the construction and continued operation of a waste abatement facility or waste discharge point (table 27).

Table 26--Primary criteria for requiring the registration of livestock and poultry producing firms, 3 States, 1971

State	Type of livestock or poultry producing operation	Minimum number of animals in confinement at one time 1/	Applicability to new and existing operations
Minnesota---	Livestock feedlots, poultry lots, and other animal lots	---	All new lots and existing lots upon request
Indiana-----	Confined feeding of cattle, sheep, swine, and fowl	300	All firms meeting other criteria
Iowa--------	Confined feeding of beef	1,000	All new firms and existing firms upon request

1/ Values presented apply to beef cattle being fed for slaughter; in some States, these values change if applicable to other types of livestock and poultry.

Criteria used to determine whether a livestock facility is eligible for registration or for the approval of an operating permit for initiating or continuing production vary among States (table 26). Most States require only that the livestock operation comply with discharge requirements specified by statute, with the means of achieving compliance left to the decision of the operator, who may choose among various alternatives and seek the approval of the water pollution control agency for the alternative which is optimally suited to his overall resource position. Other States, however, specify minimum facilities which must be constructed before registration or the issuance of a permit. In States requiring livestock producers of all sizes to

Table 27--Primary criteria for requiring registration or permits for waste discharge points or livestock waste treatment facilities, 6 States, 1971

State	Type of activity required to register or obtain permit	Size requirements	Applicability to new and existing operations
Maine	Livestock production operations	Those occupying a land area in excess of 20 acres or structure(s) on 1 parcel in excess of 60,000 square feet	All new firms meeting other criteria
Massachusetts	Livestock producers planning a discharge of waste or effluent from an abatement facility	---	All new firms
New Jersey	Livestock producers planning a discharge of waste or effluent from a disposal system	---	All firms meeting other criteria
New York	Livestock firms operating a discharge outlet or discharging from waste disposal systems	---	All new firms meeting other criteria
Pennsylvania	Livestock firms using waste treatment facilities and lagoons	1/	1/
Rhode Island	Livestock producers operating a waste discharge point	---	All new firms meeting other criteria and existing firms implementing an increase in the volume of strength of discharge

1/ Data currently available do not indicate what provisions are applicable in Pennsylvania.

install specified abatement facilities to comply with registry or licensing provisions, added investments for such facilities will be disproportionately greater for the small, family-size livestock enterprise.

In Iowa, minimum water pollution control facilities for uncovered confined beef feeding operations include terraces and retention ponds capable of containing 3 inches of surface runoff from the feedlot, waste storage areas, and other water-contributing areas. Such a requirement implies required use of specific abatement facilities for all firms, irrespective of the uniqueness of the resource position of a particular firm.

Registry requirements, approval procedures, and permit systems applicable to discharge points and waste handling systems have been promulgated under the general water quality statutes of several States (table 27). The primary criteria for registering of, or issuing a permit for, discharge points and waste handling systems are similar to those provided under specific State legislation for livestock producer registration.

In summary, a wide variety of State statutes for the control of water pollution are applicable to livestock producers in the North Central Region and Northeast States. In general, it is unlawful for the livestock producer to discharge animal wastes or waste treatment system effluents into a stream if the discharge will reduce the quality of the stream. There are inherent differences among the statute provisions plus differences that arise because of the varying degrees of enforcement being achieved or planned under them. Thus, the provisions will have varying impacts on the livestock farms required to comply with them if they are to continue production.

Differences in use-classes assigned to receiving waters among the States can also create abatement cost differences for livestock producers. For example, pollution abatement costs would be disproportionate for two dairy farms producing the same quantity of milk with similar resource bases, except that one dairy farm is located near a North Central Region stream with a relatively low use-class and the other is located next to a Northeast high use-class stream. The Northeast dairy farmer, to comply with the discharge requirements for the receiving stream, will incur higher abatement costs than the North Central Region dairy farmer. These differences in adjustment costs would be even greater if the statute required the Northeast dairy farmer to install and operate a specified abatement device, and the North Central region producer was allowed to select the abatement device or method that accorded best with his overall resource position.

The degree of enforcement which will be achieved for the various State statutes can be expected to vary considerably. The differences in statute provisions among States will render some provisions more enforceable than others. When statute provisions are identical among States, the degree of enforcement achieved will vary with the resources available to State pollution control agencies and the magnitude of the abatement task in relation to the budgets allowed for enforcement. 6/

IMPEDIMENTS TO POLLUTION ABATEMENT

Family farmers, as the term implies, have their homes and businesses at one location in most instances. They are therefore especially concerned with the environment and quality of life at their farms and in the local community. Why, then, do pollution problems exist at all? Why have not farmers achieved complete control of the wastes from their livestock operations? There are several closely related reasons why some pollution problems exist and may continue to exist for some time unless external influence of some kind is brought to bear.

Uncertainty and Lack of Knowledge

Farmers are confronted with a twofold problem in proper management of livestock wastes. First, the effectiveness of various control measures is sometimes unknown. Only continued research and subsequent educational programs can remedy this problem. Second, great uncertainty exists regarding the degree of environmental quality that will eventually be demanded by society and the control measures that will be needed to achieve that quality. The cost of installing facilities that may not satisfy regulations yet to be specified has placed many livestock producers in a wait-and-see position. They cannot afford to do the job twice. This uncertainty has probably hampered adjustments for pollution abatement as much as any other single factor in recent years.

Lack of Economic Incentive

A higher price for livestock can eventually offset any increased cost for pollution abatement, but a reduction in supply or an increase in demand are the only ways to achieve a price increase in a free market. It would be irrational for an individual farmer to reduce or cease production to affect supply, and hence price, because the benefits would accrue only to those remaining in production. The individual has no control over demand for livestock and changes in demand are generally long-term phenomena. Hence, the market does not offer the livestock farmer an economic incentive to abate pollution.

6/ States are encouraged to cooperate in the enactment and enforcement of laws relating to water pollution as provided for by the "Federal Water Pollution Control Amendments of 1971" (Section 103). Further, the law requires that Federal standards of performance for the control of pollution from a variety of sources be established and insures that State procedures for applying and enforcing the standards be approved (Section 306). To the extent that State standards are more stringent than Federal standards (which seem to be the general case), important differences will still occur.

Further, farmers, like other businessmen, have organized their operations in a rational way for profit. So long as some resources can be used free, farmers will tend to use them. A clear set of regulations, coupled with specified penalties for failure to comply, is one way to provide economic incentive. Government assistance on pollution abatement costs is another way. Other possibilities exist, but none has yet been brought clearly and forcefully to bear on a widespread basis so that the economic impact of alternative courses of action is clear to farmers.

Diseconomies of Small Size

Some pollution control measures cost little and can be applied in enterprises of almost any size at about the same cost per unit of livestock. Most, however, especially some of the recent technological innovations, would require high initial outlays regardless of size of enterprise. Unit costs are prohibitively high for the small-volume producer. The same situation also generally holds for most new kinds of livestock equipment and housing.

Rapid growth in both size of farms and size of enterprises, coupled with the drop in farm numbers of about 100,000 farms nationally per year since 1950, mostly from smaller size groups, is ample evidence of the severe economic pressure that was on the smaller farms well before pollution from livestock production was considered to be much of a problem.

Old Age and Tenancy

The operation of family farms is affected by the age and consequent planning horizon of the persons in control of and dependent upon the resources involved. Young men just starting in business are usually short of capital for all purposes. Then, as people pass middle age, they become less interested in making long-term investments. Future returns are discounted at a higher rate. Security and immediate income become relatively more important. Thus, the incentive to make long-term income-producing investments is relatively low for older people and especially low for an investment which only increases costs in the short run. Pollution abatement falls largely in the latter category.

Illinois farmers averaged 50 years of age in 1969 (table 9). Twenty-five percent were between 55 and 64 years old, while 13 percent were 65 and older. Thus, a high percentage had a relatively short planning horizon.

The situation is further aggravated by the tenure status of the farm operator and age of the landowner. In 1969, 55 percent of all Illinois farmers were either full tenants or only part-owners of the land they farmed. Any permanent improvements, livestock waste management systems included, to be installed on rented land are largely the responsibility of the landlord since all but portable equipment becomes part of the land.

Precise data are not available, but it is known that landlords in family farming areas are generally older persons and many are women. In a recent study of the western Illinois livestock region, 42 percent of the landlords were found to be women, 95 percent of whom had inherited their land. 7/ Of 426 women landowners in one county, 59 died during one year and another 92 were confined to a hospital or nursing home. Average life expectancy of the entire group was estimated to be about 7 years. 8/ Persons of this age need immediate cash income and have virtually no incentive to make investments, especially those that produce no income. Thus, many tenants cannot act to abate pollution or add any permanent facility, unless they do so at their own expense and risk nonrecovery of the investment.

Lack of Technical Assistance

Family farms on which livestock are produced exist in an almost unlimited combination of circumstances as to size, combination of enterprises, type of soil, slope of land, distance from residential areas, proximity to streams (which have different types of usage), and the like. They are therefore confronted with a multitude of different problems. Farmers do not have the know-how to do the job themselves with assurance.

Programs of technical assistance to help producers solve animal waste management problems are currently available through the Soil Conservation Service, the Extension Service, the Environmental Protection Agency, and, to a lesser extent, through State agencies in some States. The quality of technical assistance is generally high, based on research knowledge presently available, particularly for family farm operations. However, in many instances, the demand for technical assistance exceeds the supply available. This problem will become more acute in the future as producers attempt to comply with environmental control regulations.

7/ Reiss, F. J. Farm Lease Practices in Western Illinois. Ill. Agr. Expt. Sta. Bul. 728. Mar. 1968. P. 40.

8/ Wright, Harry. Principles of Setting up a Special Extension Education Program for Lady Landowners. Unpublished M.S. thesis. Univ. of Ill. Feb. 1969.

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